

Policy: 6785-2- Left Turn Phasing

Section: Traffic Signals

Office/Department: Office of Traffic Operations

Reports To: Division of Operations

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The purpose of this policy is to provide guidance concerning the use of permissive-only, protected-only and protected/permissive turn phases at signalized intersections.

LEFT TURN PHASING

Protected left turn phases for signals at intersections are often overused or misused and can cause an intersection to function with less capacity than is desirable. Typically, left turn phases are not to be used at new or upgraded traffic signal installations unless justified based on the criteria below. Left turn phases should not be used at intersection approaches where a left turn lane has not been provided.

1. The cross-product, one hour left turn volume times the opposing one hour through movement volume divided by the number of lanes for the opposing through movement, is greater than 50,000.

$$V_{lt} * V_o \div N_o \geq 50,000$$

Where: V_{lt} = left-turn flow rate, vehicles/hour

V_o = opposing through movement flow rate, vehicles/hour

N_o = number of lanes for the opposing through movement

Example:

SR XX @ Side Street Y

SR XX EB peak hour (5:00pm to 6:00pm) left turn volume is 113 vph = V_{lt}

SR XX WB through peak hour (5:00pm to 6:00pm) volume is 893 vph = V_o

SR XX is a four lane roadway, therefore $N_o = 2$

$$V_{lt} * V_o \div N_o \geq 50,000$$

$$113 * 893 \div 2 = 50,454 \text{ (cross-product is greater than 50,000; therefore, a left turn phase is warranted)}$$

2. The left turn volume exceeds 125 vehicles per hour.

$$V_{lt} = 125 \text{ veh/h} \quad (\text{Where: } V_{lt} = \text{left-turn flow rate, vehicles/hour})$$

3. Correctable crashes equals or exceeds 4 crashes in one year or 6 crashes in two years.
4. Additional criteria, including but not limited to: sight distance, speed of opposing traffic, number of left turn lanes, insufficient left turn lane storage, number of opposing through lanes, delay, the angle of the left turn and if the signal is included in a coordinated signal system will also be taken into consideration when evaluating requests for left turn phases.

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Protected-Only Left Turn Phasing

Left turn phasing will typically be installed as a protected/permissive left turn movement if at all possible. This will keep the intersection capacity and efficiency at the highest possible operation level. A protected-only left turn phase will only be allowed when conditions satisfy one or more of the following criteria:

1. Left turn crashes under a protected/permissive phasing equals or exceeds 5 crashes in 2 years for the proposed movement
2. Dual left turns
3. Limited sight distance will not allow permissive turns
4. Conflicting left turn paths
5. Opposing traffic is approaching in three or more lanes at speeds greater than or equal to 45 mph
6. Additional criteria such as unusual intersection geometrics or a high volume of pedestrians

Decisions on the use of left turn phases will be approved by the State Traffic Engineer. Request for left turn phase approvals should be accompanied by supporting documentation as outlined above. An approved traffic signal permit revision shall be required for existing signalized intersections before the addition or modification of any left turn phases.

Split Phasing

Split phasing at a signalized intersection can significantly impede the capacity of the intersection and should only be implemented after documentation has been submitted and the permit has been approved by the Office of Traffic Operations. Documentation should satisfy one or more of the following criteria:

1. Paths of opposing left turn movements conflict but the preferred lead/lag operation is not desirable
2. Side street has shared through/left
3. Limited sight distance
4. Unbalanced opposing traffic volumes, where opposing movement does not need to be served each cycle, thus resulting in reduced intersection delay
5. Crash History
6. Additional criteria such as unusual intersection geometrics (such as offset side streets or left turn lane next to shared through/left)

FLASHING YELLOW LEFT TURN ARROWS

A flashing yellow arrow (FYA) left turn signal head should be installed where protected/permissive left turn operation is warranted. FYA is the preferred alternative over the five-section “dog-house” signal head configuration when new signals are installed or signals are substantially upgraded.

The installing agency should conduct public outreach prior to the installation of FYAs in a new area, which should include media segments (radio and television), pamphlets, mailings addressed to the surround public and/or portable message signs. The regulatory sign R10-5a, explaining the flashing yellow arrow operation to approaching motorist, should be placed on the mast arm or span wire adjacent to the flashing yellow arrow signal head to coincide with the public outreach.



A five-section (dog-house) left turn signal head should not be used as a protected/permissive left turn treatment at the same intersection that a FYA signal head has been installed. When the intersection is in flash, due to a malfunction, the FYA head shall

flash the red arrow. The clearance interval of the FYA signal head should not extend beyond the clearance interval of the opposing through movement in order to limit loss time and provide operational benefits to the intersection.

A FYA left turn signal head may operate intermittently as a protected-only left turn movement based on engineering judgment. A four-section FYA head cannot be used as protected-only head full time at an intersection; if a FYA signal becomes protected-only full time, the FYA signal head must be replaced with the appropriate protected-only left turn signal head as defined in the GDOT signal design manual.

FYA – Protected/Permissive Left Turn Phasing – Lagging Only

The FYA left turn signal may operate with a lagging only protected/permissive phase with the following reduced thresholds and should be documented appropriately in the permit file:

1. The cross-product, one hour left turn volume times the opposing one hour through movement volume divided by the number of lanes for the opposing through movement, is greater than 30,000.
 $(V_{lt} * V_o \div N_o \geq 30,000)$
2. The left turn volume exceeds 75 vehicles per hour

FYA – Converting Single Lane Left Turn From Protected-Only to Protected/Permissive

An existing single lane, protected-only left turn phase may be changed to a protected/permissive left turn operation if the following documentation is submitted to and approved by the Office of Traffic Operations:

1. Table with the minimum required sight distance (calculated) and the field measured maximum sight distance for the movement being considered. The minimum sight distance required should be based off the calculated red clearance interval for the turn movement and the speed of opposing vehicles (see table below).

$$\text{Red Clearance Interval} = \frac{W + L}{V_{LT}}$$

W Distance from stop bar to far edge of conflicting vehicle path

L Length of vehicle (ft) - 20 ft typical

V_{LT} Design speed of left turning vehicle (ft/sec) - 25 mph typical

Minimum Left Turn Sight Distance for Permissive Operation									
Design Speed (mph)	Red Clearance Interval (sec)								
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
25	150	165	185	205	220	240	260	275	295
30	180	200	220	245	265	290	310	330	355
35	205	235	260	285	310	335	360	385	415
40	235	265	295	325	355	385	415	440	470
45	265	300	330	365	400	430	465	495	530
50	295	330	370	405	440	480	515	550	590
55	325	365	405	445	485	525	565	605	645

$$LTSD = V_{major} \left(2 + \frac{W + L}{V_{LT}} \right)$$

LTSD	Minimum Left Turn Sight Distance
V_{major}	Design speed of oncoming through traffic (ft/sec)
W	Distance from stop bar to far edge of conflicting vehicle path
L	Length of vehicle (ft) - 20 ft typical
V_{LT}	Design speed of left turning vehicle (ft/sec) - 25 mph typical

- Confirmation that all files for the subject intersection have been reviewed and that no documentation exists indicating that the Protected-Only left turn operation was installed to mitigate crashes. A protected/permmissive phase may still be considered if geometric improvements have been made since the crash history was documented.

RIGHT TURNING PHASING

Right turn phasing and overlaps can provide an operational benefit to a signalized intersection. Protected or a signalized permmissive right turn phase should only be installed if an exclusive right turn lane exists. Any protected right turn phase, including overlaps, should be shown in the phasing diagram or noted below the phasing diagram. The red right arrow should only be installed where right-turn-on-red is prohibited. Single indication of this treatment is recommended with a single right turn lane. Permissive operation should be used for dual exclusive right turn lanes if adequate sight distance is provided.

References:

None.

History:

Split Phasing section added, 4th par under Flashing Yellow Left Turn Arrows revised, FYA - Protected/Permissive Left Turn Phasing - Lagging Only section added: 09/26/14;
added to Manual of Guidance: 01/05/87
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